

Heights of rivers referred to zeros of gauges—Continued.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
<i>Black River.</i>	<i>Miles.</i>	<i>Feet.</i>	<i>Feet.</i>		<i>Feet.</i>		<i>Feet.</i>	<i>Feet.</i>
Kingstree, S. C.	60	12	9.9	7	3.4	30	7.0	6.5
<i>Lumber River.</i>								
Fairbluff, N. C.	10	6	5.2	3-7	1.2	28	3.9	4.0
<i>Lynch Creek.</i>								
Effingham, S. C.	35	12	13.4	7,8	4.1	20	8.6	9.3
<i>Potomac River.</i>								
Harpers Ferry, W. Va. ...	170	16	2.0	1,2,6,7	0.5	30	1.3	1.5
<i>Roanoke River.</i>								
Clarksville, Va.	155	12	10.4	25	0.0	19-22	1.6	10.4
<i>Sacramento River.</i>								
Red Bluff, Cal.	241	23	-0.6	16,26,27	-0.8	1-14	-0.8	0.2
Sacramento, Cal.	70	25	7.5	28-30	7.1	13-21	7.2	0.4
<i>Santee River.</i>								
St. Stephens, S. C.	50	12	8.7	3-7	4.2	25	7.8	8.5
<i>Congaree River.</i>								
Columbia, S. C.	37	15	10.2	25	0.4	21	2.1	9.8

Heights of rivers above zeros of gauges—Continued.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
<i>Wateree River.</i>	<i>Miles.</i>	<i>Feet.</i>	<i>Feet.</i>		<i>Feet.</i>		<i>Feet.</i>	<i>Feet.</i>
Camden, S. C.	45	24	26.9	25	3.1	23	9.3	23.8
<i>Savannah River.</i>								
Augusta, Ga.	130	32	28.4	2,3	7.1	19	13.0	21.3
<i>Susquehanna River.</i>								
Wilkesbarre, Pa.	178	14	6.0	1	0.0	26-30	1.9	6.0
Harrisburg, Pa.	70	17	3.0	3	0.8	24-26 23,30	1.6	2.2
<i>Juniata River.</i>								
Huntingdon, Pa.	80	24	3.3	27	2.8	15-26,30	2.9	0.5
<i>W. Br. of Susquehanna.</i>								
Williamsport, Pa.	35	20	1.1	1	0.4	19,21 23-25	0.6	0.7
<i>Waccamaw River.</i>								
Conway, S. C.	40	7	4.9	3,4	3.0	28-30	4.2	1.9

*Distance to Gulf of Mexico.

THE WEATHER OF THE MONTH.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

The statistical aspects of the weather of the month are presented in the tables which form the closing part of this REVIEW. Table I, in particular, contains numerous details that are important in the study of climatology. The numerical values in the tables have been generalized in a number of cases, the results appearing on Charts Nos. III to VII, inclusive.

PRESSURE AND WIND.

Normal conditions.—The geographic distribution of normal barometric readings at sea level and under local gravity for September is shown by Chart V of the MONTHLY WEATHER REVIEW for September, 1893.

Normal pressure in September is highest (30.10) on the Virginia coast, whence it decreases westward to the Mississippi Valley (30.05), and the Plains region (30.00). It is also high (30.00) on the north Pacific coast. Normal pressure is lowest (29.90) in the lower Colorado and upper Saskatchewan valleys.

As compared with August there is generally an increase of pressure in all regions save the extreme north Pacific coast and over the southern part of the Florida Peninsula. The greatest increase, 0.5 inch and over, occurs from New England and the Middle Atlantic States westward to the Mississippi Valley and over the northern Rocky Mountain and Plateau regions. The pressure changes of September mark the beginning of the return of winter conditions, viz, a building up of the South Atlantic and Plateau highs and a general increase of pressure over all sections.

In September the winds of the South Atlantic coast States are northeasterly and easterly, and there is also a marked eastward tendency noticeable south of the thirty-seventh parallel and westward to the Plateau region. In Texas and elsewhere on the Plains southeasterly winds prevail as in the preceding month. The winds of New England are offshore as a rule. Southerly winds prevail in the middle and upper Mississippi Valley, becoming southwesterly in the Lake Region. The winds of the upper Missouri Valley are generally from a northerly or westerly quarter, those of the Plateau and Rocky Mountain regions are westerly, except in cases largely controlled by local conditions.

The current month.—The distribution of monthly mean pressure is shown on Chart IV. The configuration of the isobars corresponds closely with normal conditions except possibly in the Rocky Mountain region.

Pressure was below normal in almost all parts of the

country, the only notable exception being over the southern half of Virginia, the Carolinas, and the northeastern corner of Florida. The greatest departure from normal conditions (.05 to .10 inch) occurred over a strip of territory extending from Texas to the Saskatchewan Valley and eastward from the upper lakes to St. Johns, N. F.

The distinguishing features of the month, as regards atmospheric pressure, was the relatively large number of disturbances having their origin on the southern Slope, Texas, or the west Gulf.

The character of September weather in the Gulf and South Atlantic States, whether warm and dry or broken by periods of wet and relatively cool weather, is largely dependent upon the origin and movement of atmospheric disturbances. In September, 1895 and 1896, no storm was generated in the west Gulf, Texas, or the southern Slope; the weather was accordingly warm and dry. During the current month several disturbances appeared in the Gulf, one of which remained in approximately the same position for about seventy-two hours before beginning to move inland, giving, in the meantime, cloudy weather and abundant rains on the coast.

The heavy rainfall on the immediate Gulf coast, particularly the western portion of it, is largely due to disturbances of this class.

TEMPERATURE OF THE AIR.

Normal conditions.—The normal temperature of the air in the United States in September varies from about 82° at Key West, 78° at Jacksonville, 78° at New Orleans, 80° at Galveston, 67° at San Diego, to 56° at Eastport, 62° at Burlington, 62° at Buffalo, 63° at Detroit, 56° at Duluth, 53° at St. Vincent, 55° at Havre, 58° at Spokane, and 57° at Seattle, on Puget Sound. The warmest regions are the lower Rio Grande Valley and southwestern Arizona, including a portion of the desert region of California; the coolest, the mountainous portions of Montana and Idaho and the north Pacific coast. The seacoast is cooler than the interior on corresponding parallels.

In studying the distribution of monthly mean temperatures it will be found very helpful to consult the charts at the end of this REVIEW, especially No. VI, Surface Temperatures, Maximum, Minimum, and Mean. This chart gives a very good idea of the variations of temperature with latitude

and longitude, and also of the distribution of normal surface temperatures. Chart VI for any month will differ from a normal chart merely in the displacement or bending of the isotherms northward or southward according as the temperature of the particular locality is above or below the normal for the place and season.

The current month.—The month opened with a period of extremely warm weather for the season, the abnormal conditions extending from the lower Lake region to the Atlantic coast. The crest of the warm wave was reached on the 3d, but the temperature remained high several days thereafter. A cool wave set in over the Rocky Mountain region on the evening of the 5th, and gradually extended eastward and southward, reaching the Gulf and Atlantic coasts by the morning of the 8th. Relatively low temperatures prevailed in the central valleys and the States of the Atlantic seaboard until about the 14th, after which date the temperature rose to above normal, remaining so, excepting for a brief interval about the 21st, until the end of the month.

The average temperatures of the respective geographic districts, the departures from the normal of the current month and from the general mean since the first of the year, are presented in the table below for convenience of reference:

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England.....	10	68.6	+ 2.3	+12.1	+ 1.8
Middle Atlantic.....	12	69.7	+ 2.7	+15.4	+ 1.7
South Atlantic.....	10	76.2	+ 2.2	+ 9.4	+ 1.0
Florida Peninsula.....	7	80.7	+ 1.7	+ 4.3	+ 0.5
East Gulf.....	7	77.7	+ 1.3	+ 5.3	+ 0.6
West Gulf.....	7	78.1	+ 2.1	+13.6	+ 1.5
Ohio Valley and Tennessee....	12	72.4	+ 3.9	+18.6	+ 2.1
Lower Lake.....	8	66.8	+ 3.7	+25.6	+ 2.8
Upper Lake.....	9	68.1	+ 3.8	+25.3	+ 2.8
North Dakota.....	7	57.2	+ 1.0	+23.8	+ 2.6
Upper Mississippi.....	11	68.5	+ 3.5	+21.6	+ 2.4
Missouri Valley.....	10	68.0	+ 2.5	+23.5	+ 2.6
Northern Slope.....	7	58.6	+ 0.5	+10.6	+ 1.2
Middle Slope.....	6	68.0	+ 0.6	+11.3	+ 1.3
Southern Slope.....	5	71.9	- 0.1	+ 5.8	+ 0.6
Southern Plateau.....	12	72.6	+ 1.2	+ 1.1	+ 0.1
Middle Plateau.....	9	62.3	+ 0.6	- 3.4	- 0.4
Northern Plateau.....	11	59.6	+ 0.7	+ 8.7	+ 1.0
North Pacific.....	9	58.7	+ 1.7	+ 9.3	+ 1.0
Middle Pacific.....	5	62.2	- 0.9	- 5.9	- 0.7
South Pacific.....	4	69.3	+ 0.9	+ 3.3	+ 0.4

Maximum temperatures of 100° and over were observed on both sides of the Rocky Mountains. On the eastern side the region of high maxima included the central portion of South Dakota, and a rather narrow strip extending from southern Nebraska almost in a direct line to the Rio Grande Valley. West of the mountains temperatures of 100° and over were observed in California and Arizona.

Minimum temperatures below 32° occurred quite frequently in the Rocky Mountain and Plateau regions, as also in the Dakotas and northern Minnesota. The lowest temperature at any regular Weather Bureau station was 26°; at any voluntary station, 8°, viz, at Lake Morain, Colo., on the 12th.

The month as a whole was warmer than usual, especially in the upper Mississippi valley and the Middle Atlantic States.

Deaths and prostrations, due to the excessive heat of the first few days of the month, occurred in the larger cities of the Lake region and Middle Atlantic States.

The distribution of the observed monthly mean temperature of the air is shown by red lines (isotherms) on Chart VI. This chart also shows the maximum and the minimum temperatures, the former by black and the latter by dotted lines. As will be noticed, these lines have been drawn over the

Rocky Mountain Plateau region, although the temperatures have not been reduced to sea level; the isotherms relate, therefore, to the average surface of the country in the neighborhood of the various observers, and as such must differ greatly from the sea-level isotherms of Chart IV.

In Canada.—Prof. R. F. Stupart says:

Temperature was average, to slightly below, in Eastern Quebec and the extreme northeastern portion of New Brunswick, but everywhere else in the Dominion it was above average, the excess being particularly marked throughout British Columbia and also from Manitoba east to the Ottawa River, the amount above average being as much as 6° in many portions of Ontario.

FROST.

Killing frost occurred quite generally in the Rocky Mountain region and the more northern States from the 6th to the 11th, and at elevated points in a number of other States. Frost occurred at one or more stations in the States and on the dates named below: Arizona, 10, 11, 12; California, 21; Colorado, 3-14, 17, 29, 30; Connecticut, 20, 21; Idaho, 1-13, 15, 16, 17, 22, 23, 24, 27-30; Iowa, 1, 29, 30; Kansas, 7, 11; Maine, 11, 12, 13, 20, 24, 25; Maryland, 12, 29; Massachusetts, 3, 21; Michigan, 8-12, 19, 20, 25, 26; Minnesota, 1, 7-11, 19, 20, 25, 27-30; Montana, 5-12, 27, 29, 30; Nebraska, 5-14, 30; Nevada, 1-15, 25, 26, 28, 29, 30; New Hampshire, 13, 21, 22, 28; New Jersey, 23; New Mexico, 4, 5, 11, 12, 13; New York, 11, 13, 21; North Dakota, 7-12, 15, 19, 29, 30; Ohio, 11; Oregon, 22, 23, 27-30; Pennsylvania, 11, 20, 21, 28; South Dakota, 5-11, 16, 27, 29, 30; Utah, 2-8, 10-13, 15, 17, 18, 24, 25, 29, 30; Vermont, 11, 12, 13, 18, 20, 21, 22; Washington, 27-30; Wisconsin, 9-12, 20, 26, 27, 28, 30; Wyoming, 3-12, 16, 21, 23.

PRECIPITATION.

Normal conditions.—Heavy precipitation in September (4 to 6 inches and over) occurs on the Florida and Gulf coasts, and on portions of the South Atlantic coast. The normal precipitation in parts of New Jersey, northern Michigan, and in the upper Mississippi valley, approaches closely to 4 inches. Elsewhere east of the ninety-fifth meridian it varies from 2 to 3 inches. The rainfall of the Rocky Mountain and Plateau regions and the Pacific coast in general is small in amount and quite variable.

Current month.—The rainfall of the month was not well distributed, being excessive in many localities and greatly deficient in adjacent sections. Very heavy rains fell on the southern extremity of the Appalachian range, the total amounts varying from 8 to 12 inches. Immediately to the southward, in Georgia and Alabama, the total fall for the month was barely 2 inches, several stations reporting less than an inch. On the west coast of Florida and in southern Alabama, Mississippi, and Louisiana the fall was very heavy, aggregating from 8 to 18 inches. Heavy falls also occurred over other areas, viz, in Arkansas, Missouri, and Kansas.

In California the rainy season began on the 28th, quite a heavy rain falling in the southern half of the Great Valley and part of the foothills region. In a few localities the fall ranged from 1.5 to 2 inches—a very large amount for the initial rain of the season. Whatever damage was done to the fruit crop by the early rain was offset by the relief it afforded irrigation systems and the water supply of the State in general.

DESERT RAINS IN AUGUST.

Very heavy rains occurred over the desert region of San Bernardino County, Cal., during the closing days of August. No rain gauges were in the path of the storms and we are therefore unable to give definite measurements. The storms seem to have extended from Barstow, in San Bernardino County, Cal., eastward into northwestern Arizona, a distance

of about 200 miles. The San Bernardino Sun has the following interesting article concerning desert rains.

With the end of the hot wave comes the beginning of the rainy season, and although the rain has not reached the valleys as yet, it has commenced on the mountains and desert in a manner that gives promise of plenty of rain the coming season, if signs go for anything.

There have been a few showers along the mountain range before this; in fact over an inch of rain fell a few days since at Bear Valley Lake, but Saturday last commenced the real downpour for the mountain range and the desert.

Parties who came down from Bear Valley last night report that the rain was very heavy Saturday night [August 27] and most of the day Sunday. So much rain has fallen that the upper Bear Valley reservoir or lake is filled almost to its fullest capacity. This is a remarkable occurrence, considering the very low stage of the water all the past summer. This will be a present help to the supply of water for irrigation and power from that source as well as a good promise for the future.

On the Mojave desert the washout on the railroad has been very heavy since Saturday night and Sunday. Miles and miles of track have been washed away, and at places the destruction was so complete the washed out material of track and ties could not be found, but entirely new material had to be furnished for the repairs. Enormous quantities of rain have fallen, giving the whole desert such a soaking as it has been a stranger to for months.

In the Cajon Pass the damage was considerable from the heavy downpour and from the consequent landslides of the clayey soil. There were no trains between this city and the Needles for two days until the arrival of the overland that rolled in at 5:30 yesterday afternoon.

These heavy downpours of rain in this vicinity have been duplicated in Arizona and on the Colorado desert, washing out the track of the Southern Pacific, delaying trains for several days at a time. The rains have also reached far down into Mexico, and those who have watched the rain signs of former years predict from these rains a very wet winter and plenty of water.

It has been stated by civil engineers who claim to be experts that rainfalls on the mountains would not affect the wells of the valley for months or a year or two, as the water percolated very slowly through the ground. The present rain has already refuted this theory, for within two days after the rain on the mountains the artesian wells in the city gave sign of feeling the pressure and began a slightly better flow. It is evident the water from the artesian belt has reached the lowest point of the year, and from now on will begin to flow more freely.

CYCLONIC RAINS IN THE GULF STATES.

The heavy rains on the Gulf coast and the eastern flank of the Appalachians in North Carolina, bring to mind some of the conditions that produce excessive rains.

The rains of the Gulf coast are purely cyclonic, that is to say, they belong to a class of rains that are caused by the ascensional movement and consequent cooling of highly saturated air of relatively high temperature in cyclonic systems.

In the absence of cyclonic storms the rainfall of the Gulf coast is comparatively light; thus, in 1895, there being no such storms within a distance of 500 miles of the coast line, the following amounts were recorded: Pensacola, 1.41 inch, or 29 per cent of the normal; Mobile, 1.68, or 33 per cent; Port Eads, 2.06, or 34 per cent; New Orleans, 1.97, or 43 per cent; Galveston, 1.86, or 30 per cent. If now, we set against these amounts which may be considered as representing the lower limit, the amounts recorded during the current month when the conditions were most favorable for heavy precipitation, we have at once an approximate measure of the variability of September rainfall on the Gulf coast.

The amounts for the current month are as follows: Pensacola, 17.93 inches, or 373 per cent of the normal; Mobile, 16.40, 317 per cent; Port Eads, 18.44, 307 per cent; New Orleans, 13.90, 303 per cent; Galveston, 6.78, 109 per cent.

HEAVY RAIN IN NORTH CAROLINA.

The heavy rain on the eastern slope of the Appalachians in North Carolina, was doubtless due to the joint effect of the pressure distribution and the mountain ranges.

Mr. C. F. von Herrmann, Section Director, North Carolina Climate and Crop Service, in his September report gives an

account in some detail of the heavy rain of the 22d in western North Carolina from which the following is condensed:

The crest of the Blue Ridge, the highest land east of the Rocky Mountains, extends in a curved line from the northwest corner of Surry County to the southwest corner of Polk, with a considerable bend or deflection to the west, about the middle of the straight line joining the two points above mentioned. On the morning of the day during which the heaviest rain fell, the wind was from the northeast in Stokes County (Saxon) at the north end of the crest, and southeast in Polk County (Skyuka) at the south end, so that the Blue Ridge formed a trap into which the air was blown with considerable force; to escape from which it was deflected upward over the crest of the mountains. The downpour of water resulting during the short space of less than twenty-four hours was exceptionally heavy over all the counties immediately east of the Blue Ridge, in order from south to north: Polk, Rutherford, McDowell, Burke, Caldwell, Wilkes, and Surry. There was a rapid diminution in the amount of precipitation both east and west of the crest, though unquestionably the air over eastern North Carolina must have been nearly saturated with moisture, but the ascensional tendency was absent except in the west. This is indicated by the comparatively small rainfall at Charlotte (1.82 inches), Mocksville (1.53), Saxon (3.88), and less farther east, and on the west side of the mountains Waynesville had only 1.70, Asheville 2.72, and Knoxville 1.08 inches for the entire storm.

The following amounts were recorded on the immediate eastern slope, and the direction of the wind as noted by voluntary observers is also given: Saxon, Stokes County, 3.88 inches, wind northeast; Mountairy, Surry, 6.02; Abshears, Wilkes, 7.01, wind east; Patterson, Caldwell, 8.00, wind east; Lenoir, Caldwell, 6.00, wind southeast; Linville, Mitchell (on crest), 7.57, wind southeast; Marion, McDowell, 6.78, wind east; Morgantown, Burke, 4.77; Skyuka, Polk, 5.61, wind southeast; Flatrock, Henderson (near crest), 5.75 inches.

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		Inches.	Inches.
New England	10	1.89	59	-1.30	+ 2.10
Middle Atlantic	12	2.34	61	-1.50	- 2.80
South Atlantic	10	3.13	59	-2.30	- 8.30
Florida Peninsula	7	4.24	53	-3.80	-10.60
East Gulf	7	11.87	265	+7.40	- 1.40
West Gulf	7	4.71	117	+0.70	- 2.90
Ohio Valley and Tennessee	12	3.88	130	+0.90	+ 1.20
Lower Lake	8	2.89	100	0.00	- 0.80
Upper Lake	9	2.62	77	-0.80	- 1.50
North Dakota	7	1.36	100	0.00	- 1.50
Upper Mississippi	11	4.05	128	+0.90	+ 4.50
Missouri Valley	10	3.07	119	+0.50	+ 3.20
Northern Slope	7	1.07	110	+0.10	- 0.50
Middle Slope	6	1.77	100	0.00	+ 2.30
Southern Slope	6	1.55	66	-0.80	- 1.70
Southern Plateau	13	0.17	20	-0.70	- 1.80
Middle Plateau	9	0.13	18	-0.60	- 1.70
Northern Plateau	11	0.55	65	-0.30	- 2.70
North Pacific	9	3.59	113	+0.40	- 5.40
Middle Pacific	5	0.83	114	+0.10	- 8.10
South Pacific	4	0.35	233	+0.20	- 4.90

The geographic distribution of precipitation is shown on Chart III, and the numerical values for about 3,000 stations appear in Tables II and III, while the details as to excessive rains will be found in Table XI.

In Canada.—Prof. R. F. Stupart says:

The rainfall was below average from Vancouver Island across the Rockies to a line drawn north and south from Prince Albert; below in eastern Quebec and the extreme eastern portions of the Maritime Provinces, and also below in that part of Ontario contained in the country from the Georgian Bay and Lake Huron south to Lake Erie, and east to about the extreme western margin of Lakes Simcoe and Ontario.

The greatest deficiency occurred at Parry Sound, 1.3 inch below average, and the greatest general deficiency was in Alberta, from 0.4 to 0.8 inch. In all other portions of Canada the rainfall was above average; this was especially the case at Montreal, where the amount was exceeded by 3.1 inches, at Port Arthur by 2.2 inches, and at Qu'Appelle by 2.3 inches. Locally, in the Niagara Peninsula the rainfall was much in excess of average, particularly so at Welland, where the total rainfall amounted to 5.1 inches, or 1.6 above average.

SEVERE HAILSTORMS.

The following account of severe hailstorms has been compiled from press dispatches, reports of Climate and Crop section directors, and the statements of regular and voluntary observers:

5th. An extraordinary hailstorm swept over northwestern Missouri on the afternoon of the 5th, an account of which appears on subsequent pages of this REVIEW.

14th. A hailstorm, described in the local press as terrific, struck Cape Girardeau, Mo., at 1:45 p. m., lasting fifteen minutes. The hailstones varied in size from that of a marble to a hen's egg. The deluge of hail stopped all traffic, demolished window panes on the western side of buildings, denuded trees of fruit and foliage, and covered the ground to a depth of 3 or 4 inches with a mass of icy hailstones. Churches and school buildings suffered the greatest damage, the loss in glass alone in extreme cases reaching from \$75 to \$100.

26th. Heavy hail fell over the Niagara Peninsula in connection with a tornado that occurred in the afternoon. The hail fell principally outside of the tornado track.

The following are the dates on which hail fell in the respective States:

Arizona, 10. Arkansas, 10. California, 30. Colorado, 9, 10. Connecticut, 7. Delaware, 26. Illinois, 5, 6, 15, 25, 27. Indiana, 5, 6, 15, 16, 24, 30. Iowa, 4, 5, 9. Kansas, 4, 5, 6, 9, 11, 16, 17. Kentucky, 15, 26, 27. Maryland, 26. Massachusetts, 1, 2, 17. Michigan, 14, 15, 24. Minnesota, 29. Missouri, 4, 5, 6, 12, 14, 15, 16, 17, 21, 23, 25, 30. Montana, 2, 3, 5, 22. Nebraska, 2, 4, 5, 12. Nevada, 28, 30. New Hampshire, 20. New Jersey, 7, 26. New Mexico, 10, 16. New York, 2. North Dakota, 8, 24. Ohio, 6, 24, 25, 26, 29. Oklahoma, 16. Oregon, 22, 28, 29, 30. Pennsylvania, 4, 17, 26, 27. Tennessee, 21. Washington, 18, 22, 29. West Virginia, 4, 26. Wisconsin, 14, 23. Wyoming, 3, 22.

Hail was reported on the greatest number of dates, in Missouri, 12; Kansas, 7.

SLEET.

The following are the dates on which sleet fell in the respective States:

California, 30. Colorado, 9, 10, 13. Michigan, 9. New Mexico, 10.

HUMIDITY.

The humidity observations of the Weather Bureau are divided into two series; the first or tridaily series began in 1871 and ended with 1887; the second or twice-daily series is continuous from 1888 to the present time.

The monthly means of the second or present series are based upon observations of the whirled psychrometer at 8 a. m. and 8 p. m., seventy-fifth meridian time, which corresponds to 5 a. m. and 5 p. m., Pacific; 6 a. m. and 6 p. m., Mountain; and 7 a. m. and 7 p. m., Central standard time.

Mean values computed from the first series are naturally not directly comparable with those of the second. In general the means of the first series are lower than those of the second, since they include an observation in the afternoon when the relative humidity of the air is near the minimum of the day. At stations in the western plateau region, however, the converse holds good, the means of the second series being lower than those of the first by amounts ranging from 0 to 10 per cent on the average of the year.

In the present state of knowledge respecting the diurnal variation in the moisture of the air, we are scarcely warranted in combining the two series in a general mean.

The current month.—The month was relatively dry in the majority of districts, the notable exceptions being the Gulf States, the Ohio Valley and Tennessee, the upper Mississippi Valley and the Middle Slope. It would seem that there should be some simple relation between the rainfall on the one hand and the cloudiness and relative humidity on the other; thus an excess of rain would imply, in general, more than the average amount of clouds and a higher percentage of relative humidity than obtains under ordinary conditions. That such a relation does not always exist may be seen by an examination of the three tables in this section giving, respectively, the averages of rainfall, humidity, and cloudiness, for the various geographic districts. (See, for example, the North Pacific for the current month.)

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	81	— 1	Missouri Valley.....	65	— 2
Middle Atlantic.....	76	— 1	Northern Slope ...	51	— 2
South Atlantic	82	— 1	Middle Slope	60	+ 2
Florida Peninsula	81	— 1	Southern Slope.....	58	— 4
East Gulf	82	+ 5	Southern Plateau	38	— 9
West Gulf	79	+ 5	Middle Plateau	31	— 6
Ohio Valley and Tennessee.	77	+ 4	Northern Plateau.....	52	— 0
Lower Lake	73	— 1	North Pacific Coast.....	76	— 5
Upper Lake	77	— 1	Middle Pacific Coast.....	66	— 2
North Dakota	64	— 1	South Pacific Coast.....	64	— 1
Upper Mississippi Valley....	75	+ 3			

In using the table by means of which the amount of moisture in the air is computed from the readings of the wet and dry bulb thermometers, the pressure argument has almost always been neglected, an omission that has little significance except for low temperatures and at high stations, such as Santa Fe, El Paso, Cheyenne, and a few others. The failure to apply a correction for the influence of pressure on the evaporation and therefore on the temperature of the wet-bulb thermometer has had the effect of making the monthly means of relative humidity at high-level stations too small by quantities ranging from 5 to 10 per cent. In the application of the monthly averages of the above table, or those of individual stations in Table I, to special inquiries, whether in the departments of biology, climatology, or sanitary science, this fact should be kept in mind. It should also be remembered that the hours at which observations in the Rocky Mountain Plateau region are made, viz, at 5 or 6 local mean time, morning and afternoon, give approximately the maximum and minimum values of the relative humidity for the day; probably the means of such hours approach more nearly the true mean of the month than is the case on the Atlantic seaboard and in the seventy-fifth meridian time belt.

SUNSHINE AND CLOUDINESS.

The quantity of sunshine, and therefore of heat, received by the atmosphere as a whole is very nearly constant from year to year, but the proportion received by the surface of the earth depends upon the absorption by the atmosphere, and varies largely with the distribution of cloudiness. The sunshine is now recorded automatically at 21 regular stations of the Weather Bureau by its photographic and at 47 by its thermal effects. The photographic record sheets show the apparent solar time, but the thermometric records show seventy-fifth meridian time; for convenience the results are all given in Table IX for each hour of local mean time. In order to complete the record of the duration of cloudiness these

registers are supplemented by special personal observations of the state of the sky near the sun for an hour after sunrise and before sunset, and the cloudiness for these hours has been added as a correction to the instrumental records, whence there results a complete record of the duration of sunshine from sunrise to sunset.

The average cloudiness of the whole sky is determined by numerous personal observations at all stations during the daytime, and is given in the column "average cloudiness" in Table I; its complement, or percentage of clear sky, is given in the last column of Table IX for the stations at which instrumental self-registers are maintained.

The percentage of clear sky (sunshine) for all of the stations included in Table I, obtained as described in the preceding paragraph, is graphically shown on Chart VII. The regions of cloudy and overcast skies are shown by heavy shading; an absence of shading indicates, of course, the prevalence of clear, sunshiny weather.

The formation of fog and cloud is primarily due to differences of temperature in a relatively thin layer of air next to the earth's surface. The relative position of land and water surfaces often greatly increases the tendency to form areas of cloud and fog. This principle is perhaps better exemplified in the Lake region than elsewhere, although it is of quite general application. The percentage of sunshine on the lee shores of the Lakes is always much less than on the windward shores. Next to the permanent influences that tend to form fog and cloud may be classed the frequency of the passage of cyclonic areas.

The current month.—The geographic distribution of sunshine and, conversely, of cloudiness, is shown on Chart VII. In general there was less cloudiness and consequently more than the usual amount of sunshine, the only notable exceptions being in the east Gulf and middle Pacific coast.

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	4.5	-0.5	Missouri Valley	3.9	-0.1
Middle Atlantic	3.8	-1.0	Northern Slope	3.7	-0.3
South Atlantic	4.8	0.0	Middle Slope	3.2	0.0
Florida Peninsula	4.3	-1.2	Southern Slope	3.3	-0.4
East Gulf	5.8	+1.4	Southern Plateau	1.4	-0.9
West Gulf	4.3	0.0	Middle Plateau	2.6	+0.1
Ohio Valley and Tennessee	4.3	-0.1	Northern Plateau	3.0	-1.1
Lower Lake	4.4	-0.4	North Pacific Coast	5.2	+0.3
Upper Lake	4.7	-0.4	Middle Pacific Coast	3.8	+1.0
North Dakota	4.1	-0.2	South Pacific Coast	2.0	-0.5
Upper Mississippi Valley	4.8	+0.1			

FOREST FIRES.

July.—Numerous forest fires were reported throughout California during the latter part of July and the 1st of August, the most destructive of which occurred in Shasta, Madera, Lake, Calaveras, Santa Cruz, Sacramento, Los Angeles, Monterey, San Joaquin, Eldorado, Placer, and Amador counties.

The forest areas of the State were generally in a very dry condition owing to the almost complete failure of the winter rains, and the progress of the fires was naturally exceedingly rapid.

August.—The July conflagration in Los Angeles County covered an area of 20 square miles, approximately. Fresh fires broke out during the middle of August and raged for about a week, devastating a territory about twice as large as covered by the July fires, but mainly on the north side of the ranges.

While no loss of life occurred, almost irreparable damage was done to the trees and forest covering on the headwaters of the San Gabriel and other small mountain streams.

September.—The most serious forest fires in the history of Colorado developed in the western counties of the State during the closing days of the month. On September 30, vast tracts of timber had been burned and fires were raging at many places, particularly in the northwestern part of the State.

Some persons ascribed the origin of the fires to the dry and parched condition of the country, little rain having fallen since April; others to the carelessness of hunters in camp, while still others believe them to have been of incendiary origin. Whatever the cause, the timber interests of the State have suffered very greatly, not only in the loss of valuable timber, but more especially in the destruction of hundreds of acres of forest covering so necessary to the conservation of the water that falls on the mountains.

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Bismarck, N. Dak.	3	50	nw.	New York, N. Y.	7	72	sw.
Block Island, R. I.	24	55	ne.	Sioux City, Iowa	29	50	s.
Dodge, Kans.	16	55	nw.	Toledo, Ohio	24	60	s.
Fort Canby, Wash.	20	58	se.	Williston, N. Dak.	28	50	nw.
Do	21	60	se.	Basseterre, St. Kitts. ...	12	54	s.
Do	28	60	se.	Bridgetown, Barbados ..	10	62	ne.
Independence, Cal.	30	52	nw.				

LOCAL STORMS AND TORNADOES.

6th.—On the afternoon of this date tornadic activity prevailed over two parallel bands in New York State and Pennsylvania; the first or westernmost extended from the southeastern portion of Wyoming County, N. Y., in a northeasterly direction, to near Phelps, in the northeastern part of Ontario County, of the same State. Three funnel clouds were observed. The first was seen near Nunda, at 1 p. m., eastern time, passing thence northeasterly for a distance of about 10 miles, wrecking farm buildings and fences at intervals in its course. No loss of life; property loss about \$5,000. The second funnel cloud was observed at Greigsville, in Livingston County, at 4 p. m., eastern time. In its course of 6 or 7 miles it wrecked 6 buildings involving a property loss of \$2,500; path 20 to 25 rods wide; moved northeast. The third storm was most violent near Geneva, Ontario County. One life was lost, several persons were injured, farm buildings were unroofed and in some cases completely wrecked, involving a loss of about \$5,000.

The second group of tornadoes had its origin in Bradford County, Pa., about 100 miles to the southeast of the first. First was observed near Columbia Cross Roads at 5:30 p. m., eastern time. Two persons were killed and 1 injured; path of great destruction 2 miles long and about 10 rods wide; property loss \$3,000; moved east. About an hour later a second tornado cloud struck the earth in the vicinity of East Masonville, Delaware County, N. Y., continuing in a northeasterly direction for some distance as a severe storm of wind and rain. One person was killed and 4 injured, where the tornado first touched the earth; the property loss was about \$2,500.

7th.—A severe storm, having some of the characteristics

of a tornado, passed over Elizabeth, N. J., at 3:20 p. m., eastern time. No casualties; property loss caused principally by the unroofing of buildings and the subsequent drenching of the contents, amounted to \$10,000. Evidently the tornado cloud was not fully developed or the damage would have been much greater.

18th.—A wind storm of sufficient strength to unroof buildings and prostrate trees, passed through a portion of Genesee County, N. Y., about 4 p. m., eastern time.

24th.—A severe storm, generally believed to have been a tornado, visited Lima, Ohio, about 2 p. m., central time. It is said that two funnel clouds united over the northeastern part of the town. The damage to property was very great, probably \$100,000. No lives were lost although about 20 persons were more or less injured.

26th.—A severe tornado, having its origin on Lake Ontario, swept across the Niagara Peninsula in a path about 300 feet wide, crossed the Niagara River at Tonawanda and disappeared only to reappear in a less destructive form in the southeastern part of Erie County. It crossed into Genesee county north of Alden and was last observed at Darien at a distance of 45 miles in an air line from the point of origin. The funnel cloud was first observed on Lake Ontario. Accounts differ as to the time it passed St. Catharines, Ont.; one account gives the time as 2:30 p. m., another 3:25 p. m., and a third as 3:45 p. m. It crossed the Niagara River at Grand Island and struck Tonawanda between 4:30 and 5:00 p. m.

At Alden in Erie County as many as three funnel clouds were observed, none of which endured for any length of time. The observer at the last-named place reports an exceedingly rapid rate of movement, probably 60 miles per hour. Five persons were killed at Merritton and vicinity, and probably 18 or 20 injured throughout the course of the storm. The property loss was large, estimated as \$100,000 at St. Catharines, \$200,000 at Merritton, and \$70,000 at Tonawanda, total \$370,000. The path of the tornado was exceedingly narrow, not over 300 feet. Large hail fell on the outer edges. The barograph at the Buffalo Weather Bureau office, 4 miles distant from the funnel cloud, did not show any marked disturbance at the time of the passage of the tornado. The curve for the afternoon forms a very open V, the rise in pressure occurring at the time of passage of the tornado. The maximum velocity of the wind was 42 miles per hour from the west at 5:05 p. m.

29th.—A severe local wind demolished a building in the

suburbs of Louisville, Ky., killing 1 person, the only occupant. Loss to building about \$2,000.

WATERSPOUT.

Bay St. Louis, Miss., September 29, at 6:50 p. m. a beautiful waterspout formed a short distance from shore, and went in a westerly direction, increasing in strength. It was followed by a heavy rain for one hour. One house destroyed, two unroofed, and another lifted from pillars.—*Report of voluntary observer.*

ATMOSPHERIC ELECTRICITY.

Thunderstorms.—Two thousand six hundred and ninety-six reports of thunderstorms were received during the current month as against 1,732 in 1897, and 4,853 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country were most numerous were: 4th, 328; 5th, 210; 6th, 208; 2d, 193; 7th, 163.

Reports were most numerous from Ohio, 243; Illinois, 215; New York, 169; Missouri, 153.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, from 1st to 4th, and 25th to 30th.

The greatest number of reports were received for the following dates: 9th, 62; 2d, 59; 10th, 28; 11th, 21.

Reports were most numerous from Wisconsin, 32; North Dakota, 19; Minnesota, 17; Michigan, New Hampshire, and New York, 16.

In Canada.—Auroras were reported as follows: Yarmouth, 6, 9; Charlottetown, 9; Father Point, 9, 12, 16, 24, 28; Quebec, 9, 10, 13, 16, 20, 28; Toronto, 2; White River, 11; Kingston, 2, 3, 16; Port Stanley, 2; Port Arthur, 17; Winnipeg, 11, 13, 29; Banff, 6, 9, 10, 14; Minnedosa, 8, 10, 11, 14, 15, 29; Qu'Appelle, 11, 12, 14; Kamloops, 9; Battleford, 23; Barkerville, 2.

Thunderstorms were reported as follows: Grand Manan, 5; Bermuda, 11, 13, 14, 17, 18, 19, 22, 26, 28; Yarmouth, 3; Charlottetown, 5; Father Point, 4, 10; Quebec, 4, 9, 18, 26, 30; Montreal, 1, 2, 4, 9, 18, 19, 30; Toronto, 3, 18, 26; White River, 2, 3, 18, 21, 29; Kingston, 1, 2, 5, 18; Port Stanley, 4, 5, 6, 15, 16, 18; Saugeen, 15; Parry Sound, 15, 18; Port Arthur, 3, 22; Winnipeg, 17, 23; Banff, 20, 21; Minnedosa, 3, 23; Qu'Appelle, 1, 17; Swift Current, 1.

CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following extracts relating to the general weather conditions in the several States and Territories are taken from the monthly reports of the respective sections of the Climate and Crop Service. The name of the section director is given after each summary.

Rainfall is expressed in inches.

Alabama.—The mean temperature was 75.5°, or 3.3° above normal; the highest was 100°, at Evergreen on the 2d and 6th, and the lowest, 48°, at Riverton on the 7th and at Madison on the 9th. The average precipitation was 3.58, or 0.80 above normal; the greatest monthly amount, 16.40, occurred at Mobile, and the least, 0.46, at Sturdevant.—*F. P. Chaffee.*

Arizona.—The mean temperature was 76.1°, or 0.9° above normal; the highest was 118°, at Parker on the 10th, and the lowest, 27°, at Flagstaff on the 12th. The average precipitation was 0.36, or 0.55 below normal; the greatest monthly amount, 2.11, occurred at Bisbee, while none fell at many stations.—*W. G. Burns.*

Arkansas.—The mean temperature was 75.1°, or 1.9° above normal; the highest was 104°, at Conway on the 2d, and the lowest, 42°, at Ore-

gon on the 8th. The average precipitation was 7.35, or 4.07 above normal, and the highest average for September on record; the greatest monthly amount, 21.95, occurred at Moore, and the least, 3.26, at Amity.—*Geo. G. Harkness.*

California.—The mean temperature was 69.2°, or 1.3° below normal; the highest was 117°, at Volcano Springs on the 8th and 19th, and the lowest, 14°, at Sneddens Ranch on the 3d. The average precipitation was 0.70, or 0.31 above normal; the greatest monthly amount, 4.09, occurred at Las Fuentes, while none fell at many stations.—*G. H. Willson.*

Colorado.—The mean temperature was 57.1°, or 1.7° below normal; the highest was 99°, at Crook, Lamar, and Minneapolis on the 2d, and the lowest, 8°, at Lake Moraine on the 12th. The average precipitation was 0.83 or 0.19 below normal; the greatest monthly amount, 3.28, occurred at Cope, while none fell at Saguache.—*O. D. Stewart.*

Georgia.—The mean temperature was 75.3°, or 1.0° above normal; the highest was 98°, at Bainbridge on the 28th, and the lowest, 51°, at Clayton and Fort Gaines on the 13th and at Diamond on the 15th. The average precipitation was 4.76, or 1.41 above normal; the greatest monthly amount, 12.08, occurred at Dahlongega, and the least, 0.26, at Morgan.—*J. B. Marbury.*